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PUBLIC INFRASTRUCTURE INVESTMENT: ENOUGH BANG FOR THE BUCK?

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EXECUTIVE SUMMARY

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After a decade of declining capital spending, public infrastructure investment is surging in the US and Europe. Scaling up spending on infrastructure has become an essential element of the fiscal stimulus to boost economies after Covid-19. The current infrastructure impulse in the US is likely to become the largest public spending program since the 1970s, with infrastructure investment rising from 1.8% of GDP to 2.3% of GDP until 2030. In Europe, however, the scale is somewhat smaller and the duration shorter: France's ratio will increase from 2.5% to 2.7% of GDP until 2027, Germany from 1.1% to 1.4%, Italy from 0.9% to 1.3% and Spain from 1% to 1.5%.

All this investment should have a significant positive impact on growth: In the US, the infrastructure package should add about 0.9pp to GDP over the next three years, while in Europe the impact will be largest for Spain (+0.90pp) and smallest for Germany (+0.35pp). Well-planned infrastructure investment can permanently raise potential output by boosting demand in the near term and supply in the long term. In particular, more investment in sustainable infrastructure helps facilitate the transition towards low-carbon, more environmentally friendly economic models and enhances socio-economic resilience. However, significant financing will have to be mobilized from the private sector since countries often lack sufficient fiscal capacity to address the related investment needs.

Public investment can stimulate private investment through rising confidence about higher growth in the future. We estimate that the current infrastructure plans will crowd-in private capital of up to USD100bn annually in the US, EUR50bn in France and EUR10bn in Germany until 2025. We find that large debt-financed infrastructure investment is particularly powerful in raising private participation in infrastructure, albeit with a lag of about two years. Over the longer term, additional infrastructure investment is expected to boost potential output by 0.4pp and 0.2pp in the US and Europe, respectively. However, the current scale of additional capital spending may not be sufficient to meet the investment demands consistent with the goal to reduce greenhouse gas emissions by more than 50% relative to 1990 levels until 2030. Since private capital through crowding-in effects can partially meet the estimated annual investment shortfalls (USD210bn in the US and EUR137bn for the four largest European economies), the green transition will place a premium on more efficient public investment and making infrastructure a more accessible asset class for investors.

COVID-19 HAS REVERSED A DECADE OF DECLINING PUBLIC INVESTMENT IN INFRASTRUCTURE

The current surge of additional public investment in infrastructure reverses a secular decline of capital spending over more than a decade. Investment growth in most countries has been anaemic and fallen below the historical long-term average in recent years. The stock of public capital spending (i.e. gross fixed capital formation) in infrastructure has declined significantly as a share of output over the last decade (from more than 2% of GDP). Furthermore, the total cost of providing infrastructure to support global economic growth and to start closing the gaps in infrastructure investment will be USD94.0trn by 2040, according to Oxford Economics' latest Global Infrastructure Outlook (2017)[1], which would average to about 5.5% of GDP per year (and double the amount of current capital spending). In addition, further investment in climate-smart infrastructure will be necessary and raise these investment needs. In many countries, gaps in the quantity of infrastructure per capita are especially glaring. While the quality of the existing infrastructure stock is deteriorating in many advanced economies because of aging and insufficient maintenance.

Scaling up public infrastructure investment became an essential element of fiscal stimulus during the recovery phase of the pandemic. The Covid-19 crisis raised the need for more and better public investment to support the recovery.[2] Public investment is a common fiscal stimulus tool due to its high multiplier, especially during recessions, as well as its discretionary, capital-intensive and large-scale nature. Both the EU and the US have implemented ambitious infrastructure packages, and the European Commission is about to prepare plans that protect public investment and focus on green and digital priorities.

Well-planned infrastructure can permanently raise potential output by boosting both aggregate demand and potential output. Expanding infrastructure investment in essential services either relating to physical flows in the real economy (i.e. transport, energy, digitalization) or to social goods (i.e. education and healthcare)—is an effective way to promote inclusive growth and foster local resilience to global shocks. More investment spending increases demand for goods and services, and it creates jobs for both the construction and operation of infrastructure projects. The additional income is then spent elsewhere. Over the longer term, better infrastructure raises productivity through the supply-side effect of better roads, faster trains, bigger ports, more reliable energy generation, cleaner water and broader coverage of telecommunication services, lifting potential growth as a result. [3]

1 *See Oxford Economics (2017), "Global Infrastructure Outlook: Forecasting Infrastructure Investment Needs and Gaps," July (Sydney: Global Infrastructure Hub), available at https://cdn.gihub.org/outlook/live/report/Global+Infrastructure+Outlook+reports.zip.*

2 *See IMF (2020), "Ideas to Respond to Weaker Growth," Chapter 2, Fiscal Monitor, April, Fiscal Affairs Department (Washington, D.C.: International Monetary Fund).*

3 *See Rozenberg, Julie, and Marianne Faye (2019), "Beyond the Gap: How Countries Can Afford the Infrastructure They Need While Protecting the Planet. Sustainable Infrastructure." Washington, DC: World Bank, available at https://openknowledge.worldbank.org/handle/10986/31291.*

In particular, more investment in sustainable infrastructure helps finance the transition towards a low-carbon, more environmentally-friendly economic model. It also enhances socio-economic resilience, especially in healthcare and education, helping countries be better prepared to prevent and/or mitigate the financial impact of both natural disasters and pandemics.[4] Scaling up investment in resilient infrastructure would not only help prepare for and adapt to climate shocks, but also help achieve the relevant emission reduction targets, given that current infrastructure accounts for more than half of all emissions globally. The IMF estimates that climate-friendly infrastructure could boost global GDP by 0.7% in the next 15 years, create millions of jobs and pave the way to net zero emissions by 2050.[5]

However, most countries will require more private investment in infrastructure to boost capital expenditure. Countries often lack sufficient fiscal capacity[6] and domestic savings to address the infrastructure gap.[7] Limited fiscal space due to budgetary constraints and rising debt levels in many countries has led to lower government spending on capital investment (including funding for new infrastructure projects and maintaining existing ones). Both public and private balance sheets will come out of the pandemic more stretched, with higher debt for all. Nevertheless, private savings are also likely to have increased and interest rates, at least on government bonds, are likely to be low for an extended period, which could generate a search for yield by private investors. Thus, making infrastructure investment more attractive to long-term institutional investors, such as insurance companies, could be an attractive path for mobilizing private capital, given the scale of resources needed to address the estimated gap in investment. [8]

4 *See Jobst, Andreas A. (2018), "Credit Dynamics of Infrastructure Investment: Considerations for Financial Regulators," Policy Research Working Paper No. 8373, March 22 (Washington, D.C.: World Bank Group), available at http://documents.worldbank.org/curated/en/606411522326750586/pdf/124720-PUBLIC-Infrastructure-Regulation-Report-Mar28.pdf.*

5 *See IMF (2020), "Greening the Recovery," Special Series on Fiscal Policies to Respond to COVID-19, Fiscal Affairs Department (Washington, D.C.: International Monetary Fund), available at https://www.imf.org/~/media/Files/Publications/covid19-special-notes/en-special-series-on-covid-19-greening-the-recovery.ashx.*

6 *However, if government borrowing costs are much lower than returns demanded by private investors in infrastructure, private sector performance (efficiency) in building and operating infrastructure would need to be superior to what the public sector can accomplish to at least offset any funding benefits and support a compelling argument for the mobilization of private capital.*

7 *See Schwartz, Jordan Z., Ruiz-Núñez, Fernanda and Jeff Chelsky (2014), "Closing the Infrastructure Finance Gap: Addressing Risk," in: Heath Alexandra and Matthew Read (eds.) Financial Flows and Infrastructure Financing. Conference Proceedings, March 20-21 (Sydney: Reserve Bank of Australia), available at https://www.rba.gov.au/publications/confs/2014/pdf/conf-vol-2014.pdf.*

8 *See Inderst, Georg and Fiona Stewart (2014), "Institutional Investment in Infrastructure in Developing Countries: Introduction to Potential Models," Policy Research Working Paper No. 6780, February (Washington, D.C.: World Bank Group), available at http://documents.worldbank.org/curated/en/238121468325297049/pdf/WPS6780.pdf as well as Karapiperis, Dimitris (2017), "Infrastructure Investment and the Insurance Industry," The Center for Insurance Policy and Research (CIPR) Newsletter, August (Kansas City: National Association of Insurance Commissioners), available at http://www.naic.org/cipr_newsletter_archive/vol22_infrastructure.pdf.*

While the pandemic offers significant opportunities for a fundamental transformation of infrastructure systems, the current policies aimed at scaling up public investment could also face challenges. Higher infrastructure investment could amplify current supply-demand imbalances due to an acute shortage of labor and materials, especially in construction and related sectors, which could prolong inflationary pressures at a time when most countries are already closing their output gaps. There is also considerable uncertainty regarding the scale of structural change after the crisis and the demand for infrastructure and its costs, which could complicate the planning of public infrastructure projects and the risk management of public-private partnerships. For example, the demand for digital and health infrastructure will likely rise, but that for energy is unclear. While the recent oil price decline might make energy investments less attractive, it could also provide options to cancel existing projects and re-orient them towards cleaner energy generation and a more resilient energy grid. In addition, the Covid-19 crisis has also imposed financial stress on infrastructure projects/assets.[9] Many implementation delays, higher costs, lower demand and force majeure disputes during the pandemic might make it more difficult to mobilize private capital for new infrastructure projects.

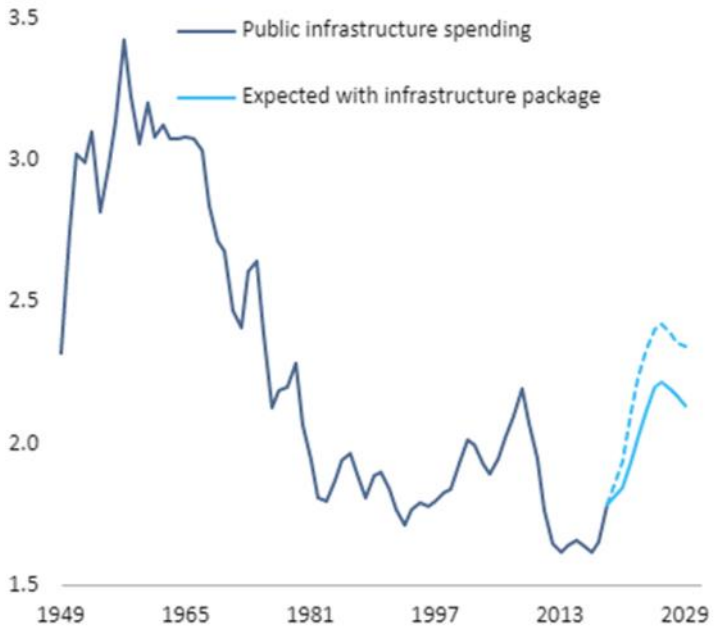
Against this backdrop, we examine the potential economic impacts of infrastructure packages in the EU (with a focus on the four largest economies) and the United States. We also investigate the scale of private investment more public spending can crowd in via confidence effects. Finally, we illustrate the potential resource re-allocation to sectors with the largest decarbonization potential to assess whether planned investments are sufficient for greening consumption and investment flows consistent with national climate change policies.

9 *See Ari, Anil, David Bartolini, Vizhdan Boranova, Gabriel Di Bella, Kamil Dybczak, Keiko Honjo, Raju Huidrom, Andreas A. Jobst, Nemanja Jovanovic, Ezgi Ozturk, Laura Papi, Sergio Sola, Michelle Stone, and Petia Topalova (2020), "Infrastructure in Central, Eastern, and Southeastern Europe: Benchmarking, Macroeconomic Impact, and Policy Issues," Departmental Paper, European Department, September (Washington, D.C.: International Monetary Fund), available at https://www.imf.org/en/Publications/Departmental-Papers-Policy-Papers/Issues/2020/09/25/Infrastructure-in-Central-Eastern-and-Southeastern-Europe-Benchmarking-Macroeconomic-Impact-49580.*

BUILD BACK BETTER AND NGEU: DRIVING THE COVID-19 RECOVERY

In the US, President Biden managed to pass the long-awaited Bipartisan Infrastructure Deal (Infrastructure Investment and Jobs Act) in mid-November 2021, while the Build-Back-Better (BBB) Framework is expected to be approved through the reconciliation process in the US Congress in mid-December 2021. After tense and still ongoing negotiations, the two programs are expected to amount to USD550bn and USD1.6trn, respectively, resulting in new fiscal stimulus of USD2.2tn. Taking into account the bi-partisan infrastructure agreement, the BBB program, and already budgeted funds, we estimate that USD 1745bn will be allocated to infrastructure projects over a 10-year horizon, which represents the largest infrastructure spending plan since the 1970s (Figure 1).

Figure 1: Scale of US infrastructure package (as % of GDP)

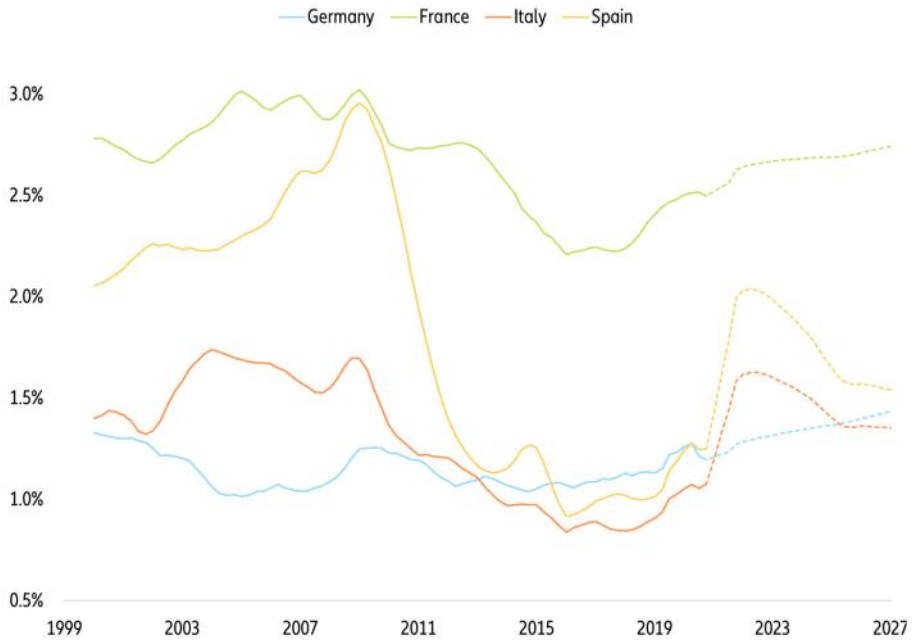


Sources: National Sources, Bureau of Economic Analysis (BEA), Refinitiv, Allianz Research.

Meanwhile, the EU adopted a recovery package ("Next Generation EU" or NGEU for short) in May 2020 to finance investment in a "green, digital, and resilient" economy. The NGEU represents a one-off augmentation of the EU's multi-year fiscal framework for 2021–27, funded by EUR750bn of EU debt issuance to be repaid over 30 years via new tax receipts accruing to the EU budget (e.g. proceeds from the carbon border adjustment mechanism, a digital sales tax and levies on large multinational corporations). More than half of the funds will be disbursed as grants to member states, while the rest takes the form of loans and supplements existing EU structural funds and provides guarantees to the European Investment Bank. For the purposes of our analysis, we assume that about 20% of the funds disbursed through the Recovery and Resilience Facility (RRF) of the NGEU will be allocated to physical infrastructure investments (with a focus on climate policy and energy transition (renewable energy systems, climate-friendly mobility, and energy-efficient housing) as well as digitalization and healthcare). We focus on the largest economies in the EU (Germany, France, Italy and Spain – or "EU-4"), which differ in the amount and projected disbursement of funds for infrastructure projects (Figure 2). Compared to the US, the supplementary planned infrastructure spending is generally small, except for Italy and Spain (Appendix II).

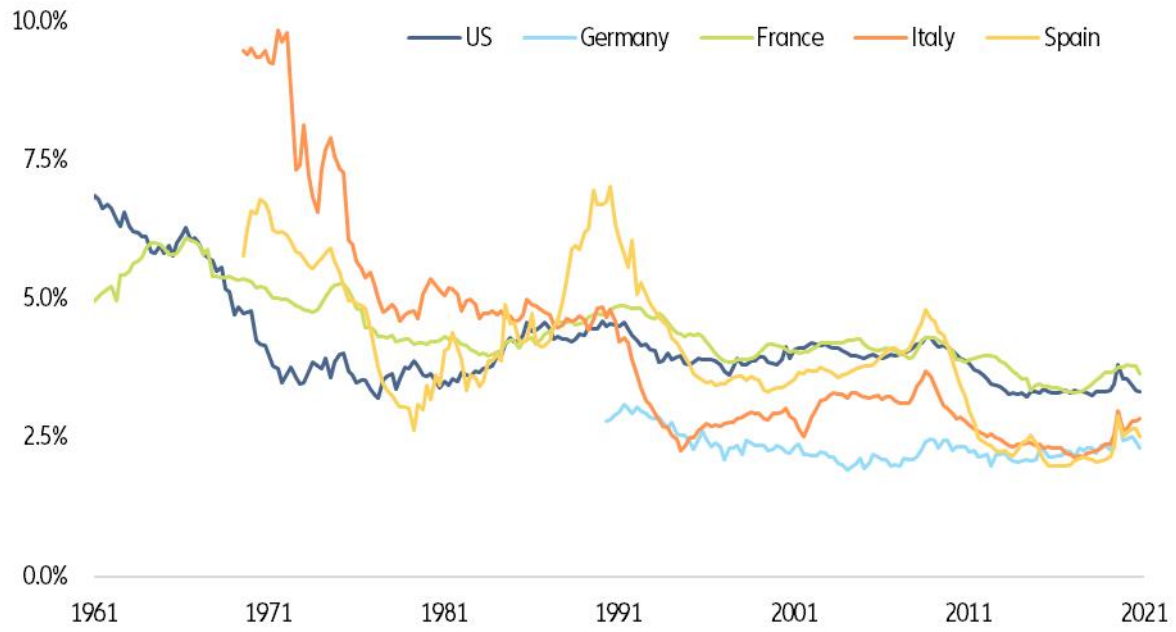
The current push for greater public investment to stimulate aggregate demand and raise productive capacity is urgently needed, even without considering efforts to mitigate the economic scarring effects from the current crisis. Europe's largest economies and the US have seen a secular decline in public gross fixed-capital formation, which accelerated after the global financial crisis but began decades ago (Figure 3). Public investment relative to output has reached record lows and is now less than half of what it was in the 1960s. However, within Europe, there are important cross-country differences. While Italy has seen the largest drop, the decline has been much smaller in France and Germany. This trend is further exacerbated by the increasing aging of infrastructure, which raises the investment need for maintenance (in addition to new construction).

Figure 2: EU-4 (Germany, France, Italy, Spain) – Size of the NGEU infrastructure investment impulse (as % of GDP)



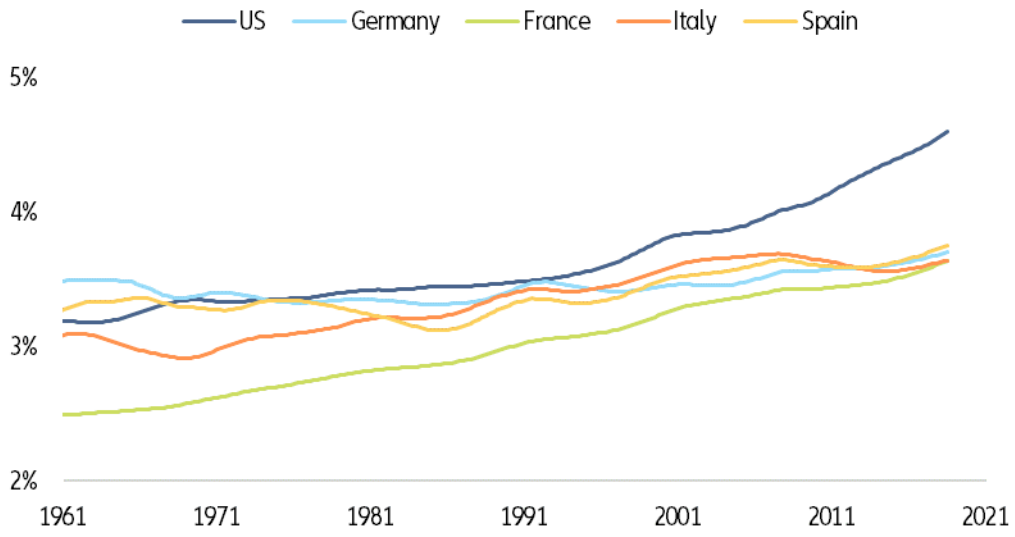
Sources: Allianz Research, Euler Hermes, and Refinitiv.

Figure 3: EU-4 and US: Public GFCF (In % of GDP)



Sources: OECD, Refinitiv, Euler Hermes, Allianz Research.

Figure 4: EU-4 and US: Depreciation rate (y/y) of capital stock (In %)



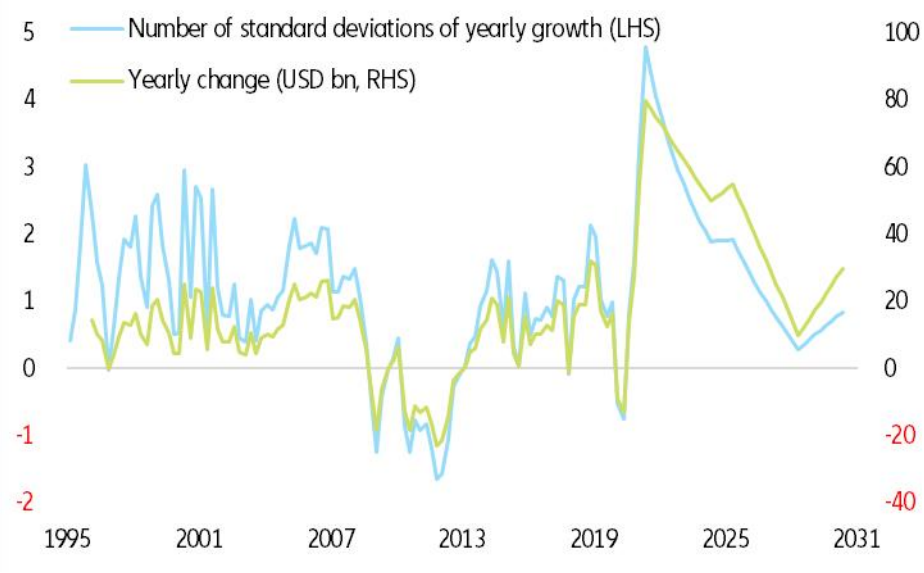
Sources: Penn World Tables, Refinitiv, Euler Hermes, Allianz Research.

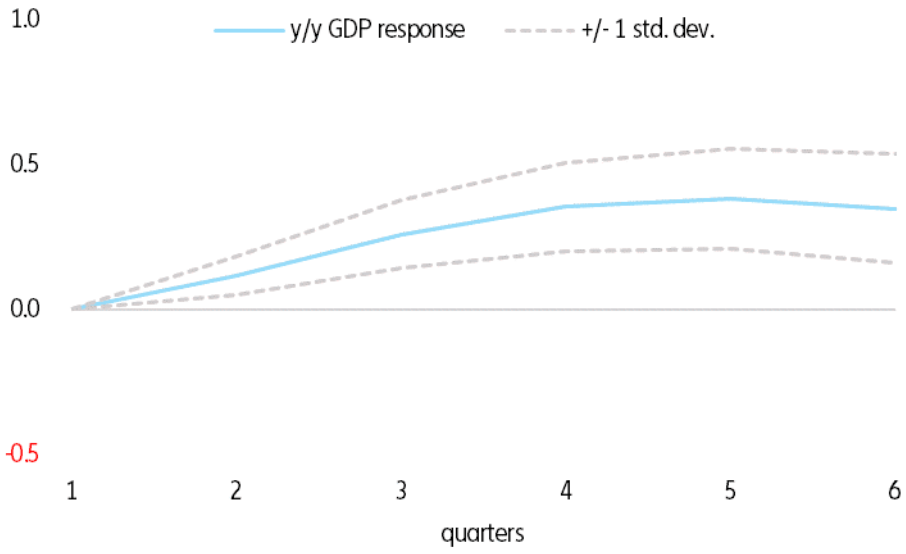
THE SHORT-TERM IMPACT ON ECONOMIC GROWTH

We examine the differential impact of the infrastructure packages on growth using implied fiscal multipliers of public investment. We specify an unrestricted vector autoregression (VAR) model to explain the annual change in real growth of Europe's largest economies and the US over a 20-year time horizon based on the annual change in public infrastructure investment, the spread between long-term and short-term interest rates and headline (CPI) inflation at a quarterly frequency of observations (Appendix III). We then measure the growth impact of additional infrastructure investment as the one-year cumulative response of real GDP growth to a one-standard-deviation-shock to the annual change in public investment using the impulse response function of our VAR model (Figures 5-7):

- In the US, for a growth elasticity of about 0.4, we estimate that the infrastructure package is likely to lift GDP growth by 0.30pp (0.45pp if the BBB program is included in capital spending) in 2022, 0.17pp (0.20pp) in 2023, and 0.16pp (0.22pp) in 2024.
- In Europe, we find similar results but with a larger impact for Italy and Spain, which receive a disproportionately higher share of NGEU funds. The impact of the additional public infrastructure investment from the NGEU is expected to lift growth over the medium term by 0.35pp in Germany, 0.45pp in France, 0.85pp in Italy, and 0.90pp in Spain. Germany and France receive less funding from the NGEU, but national governments could launch their own programs to offset the difference.

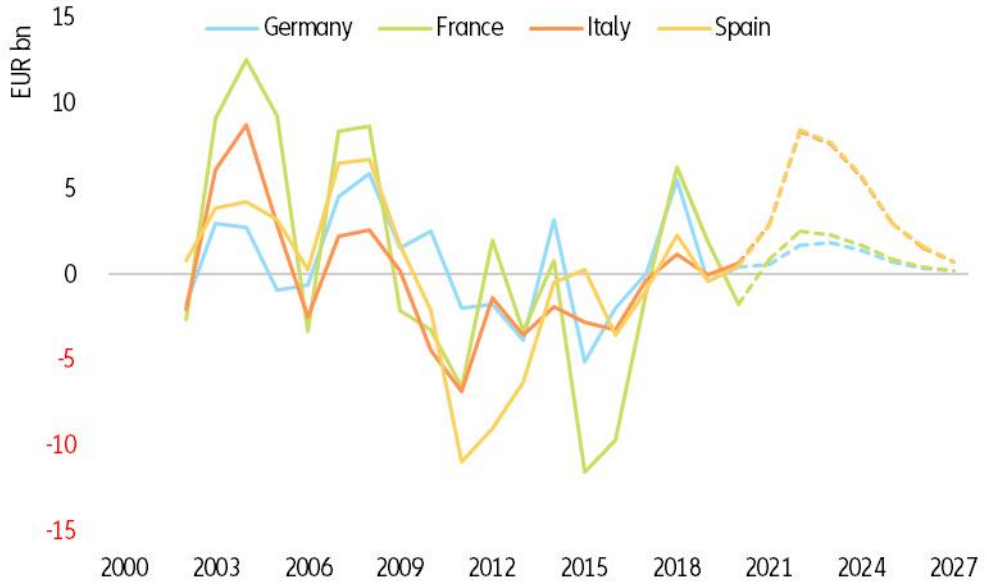
Figure 5: US-Annual growth of public spending in infrastructure (quarterly) and cumulative GDP growth in response to a one-standard-deviation shock to change in infrastructure investment





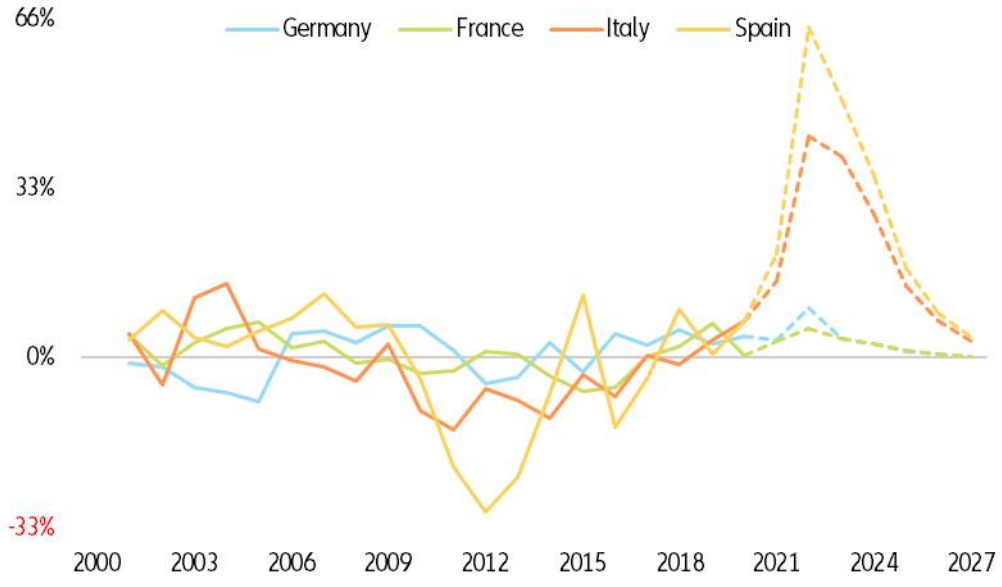
Sources: Euler Hermes, Allianz Research.

Figure 5a: Europe-Annual growth of public spending in infrastructure (in EUR bn)



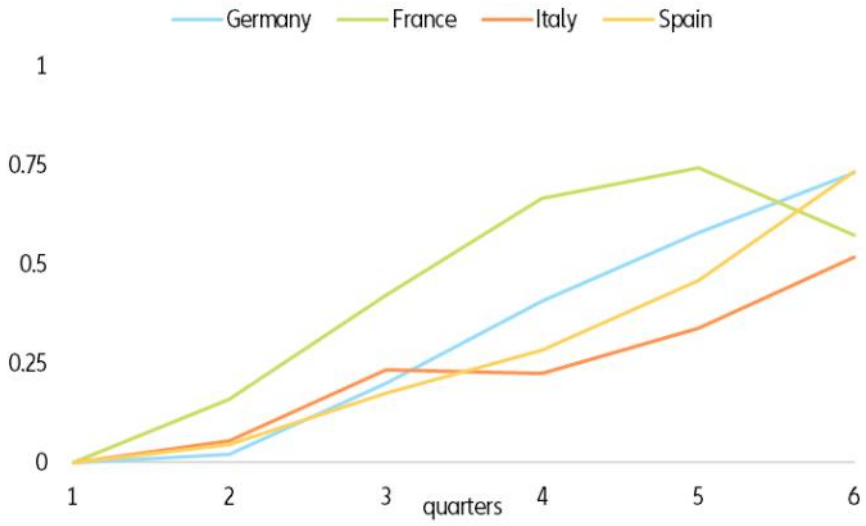
Sources: Refinitiv, Euler Hermes, Allianz Research.
Note: Dotted lines represent the additional public infrastructure investment from the NGEU recovery package

Figure 5b: Europe-Annual growth of public spending in infrastructure (in y/y change)



Sources: Refinitiv, Euler Hermes, Allianz Research.
Note: Dotted lines represent the additional % change brought by public infrastructure investment from NGEU with respect to the expected amount in the absence of plan.

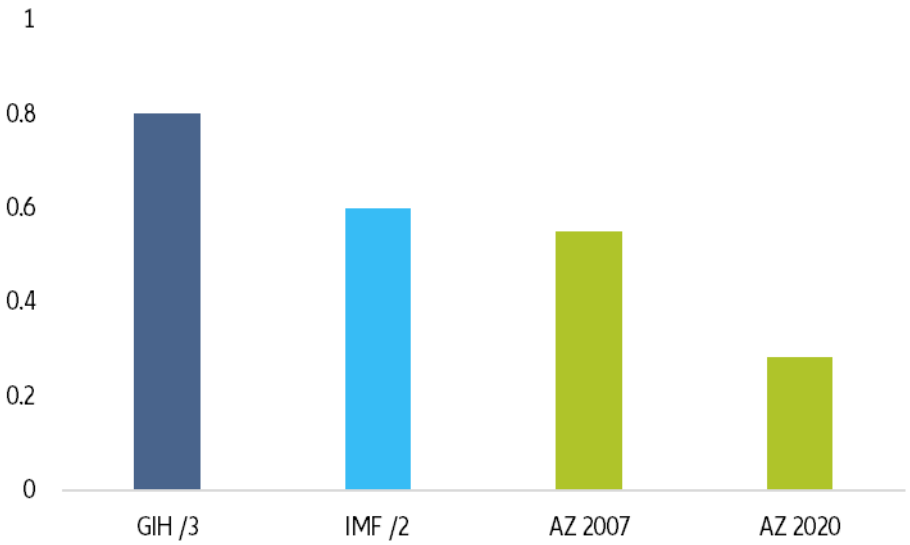
Figure 6: Europe-Cumulative GDP growth in response to a one-standard-deviation shock to change in infrastructure investment



Sources: Euler Hermes, Allianz Research.

Interestingly, we find significantly smaller fiscal multipliers compared to comparable studies on the effect of public investment on changes in aggregate demand, which might partially be explained by the fact that we apply a more precise (albeit narrower) definition of infrastructure investment in the specification of our impulse-response function (Figure 7).

Figure 7: Advanced economies-comparison of fiscal multipliers



Sources: Global Infrastructure Hub (2020), Durand and Espinoza (2021), Euler Hermes, Allianz Research.
Note: AZ=Allianz Research, AE=advanced economies. The definition of AEs may differ across sources. Our estimates (rightmost bar) show the GDP impact of a one-standard-deviation of the year-on-year change of infrastructure investment, while the multipliers for the GIH and IMF studies (Durand and Espinoza, 2021)[11] show the GDP response to a one-percentage point increase of infrastructure investment over GDP. Since the average historical volatility of public investment of our sample countries is about 1%, the two methods are comparable.

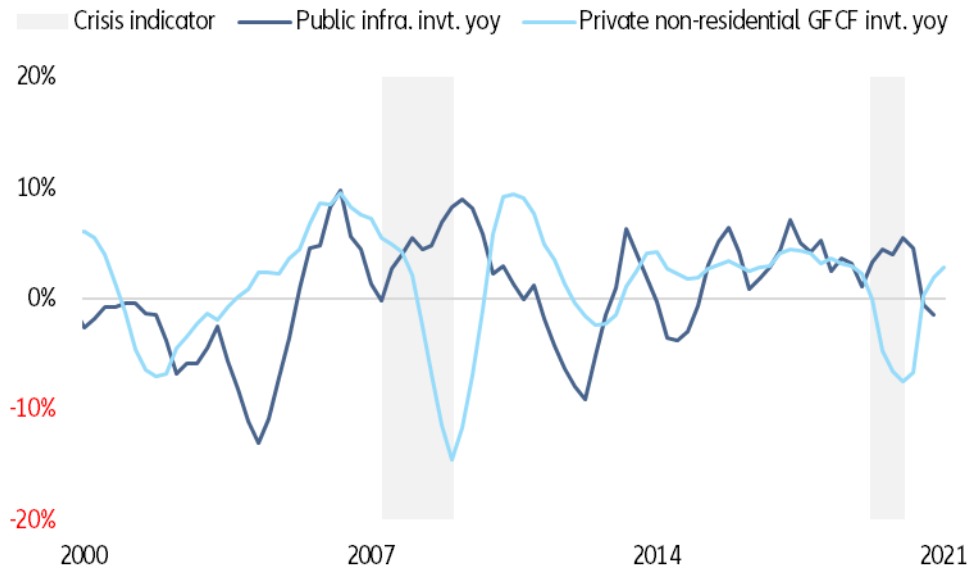
11 *See Durand, Luigi and Raphael Espinoza (2021), "The Fiscal Multiplier of European Structural Investment Funds: Aggregate and Sectoral Effects with an Application to Slovenia," IMF Working Paper No. 21/118 (Washington, D.C.: International Monetary Fund), available at https://www.elibrary.imf.org/view/journals/001/2021/118/article-A001-en.xml.*

THE CROWDING-IN EFFECT OF PUBLIC INVESTMENT

In this section, we investigate how the positive effect of public investment on aggregate demand can encourage private investment through confidence effects. When we compare the changes in public versus private investment over time, we find an interesting pattern: While public investment is mostly counter-cyclical, private investment seems to be much more cyclical. The former tends to be a common fiscal stimulus tool due to its high multiplier effects, especially when there is sufficient excess capacity in the economy during recessions. The transmission of the fiscal impulse through public investment to the rest of the economy can be very powerful but might take some time to materialize, given the long lead time of implementing infrastructure projects. For instance, in the case of Germany, we can see that during recessions (such as the global financial crisis in 2008 and, more recently, the Covid-19 crisis), public investment increases and offsets the decline of private investment, which takes some time to rebound as the economy recovers (Figure 8).

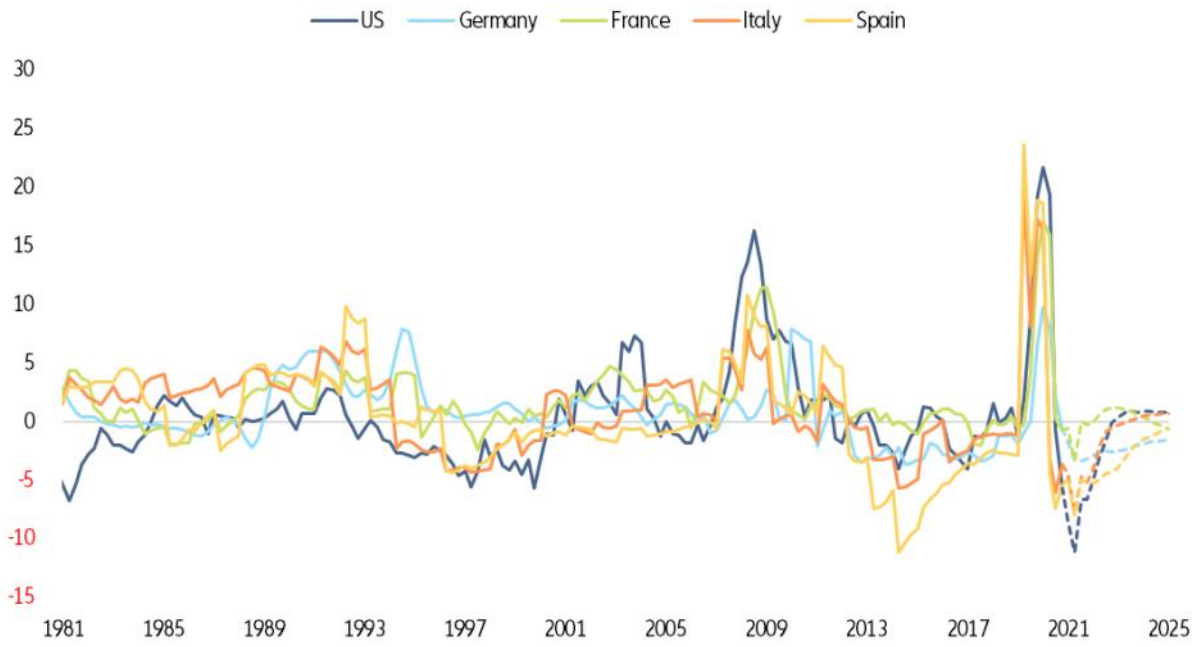
The scale of the fiscal multiplier from infrastructure projects depends crucially on the confidence channel. In this regard, the long-term commitment of governments through public investment raises expectations of future growth and creates incentives for more private investment. We capture this "crowding in" by comparing the change in public debt to the cyclical position of an economy relative to its trend growth. For instance, high public debt issuance relative to the size of the shock to output during a recession implies the government's commitment to support aggregate demand over the longer term. We define this "public preference for the future" as the difference between public debt issuance as a percentage of GDP and the output gap of the economy as a percentage of GDP. We subtract the primary deficit from this variable to control for the influence of short-term financing needs mainly related to the functioning of automatic stabilisers. Figure 9 shows that this "public preference for the future" has never been higher in any of our sample countries and is even stronger than in the wake of the global financial crisis more than a decade ago.

Figure 8: Germany-Changes in gross fixed capital formation (in % y/y)



Sources: Refinitiv, Euler Hermes, Allianz Research.

Figure 9: EU-4 and US: Public preference for the future index



Sources: Refinitiv, Euler Hermes, Allianz Research.

We can now estimate the potential crowding-in effect of recent infrastructure initiatives using the historical elasticity of private investment to large debt-funded fiscal expansion. We specify total investment as a function of the "public preference for the future" index with a lag of two years, GDP growth y/y), and the variation in the slope of the sovereign yield curve (one quarter lag). We find that the "public preference for the future" is highly significant in explaining changes in total investment (Table 1). However, the crowding-in effect of the private sector varies significantly by countries and seems to be highest in the US (at up to USD100bn per year), whereas the results indicate a more muted effect for the EU-4 countries (especially in Italy, where fiscal space remains very limited).

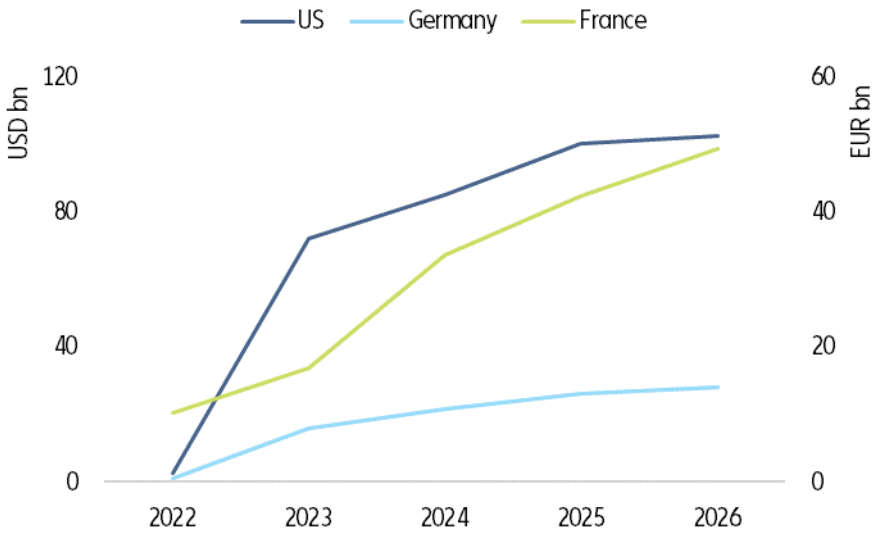
The estimated coefficient values allow us to determine the change in total investment according to the fiscal impulse and determine the share of implied private investment after subtracting the projected amount of public investment (Figure 10). For France, Germany and the US, we expect the crowding-in effect to increase over time and become meaningful only over the medium term. In contrast, we find that Italy and Spain are at the verge of crowding out the private sector because the size of the additional infrastructure investment together with the unusually high fiscal impulse could be large enough to absorb all investment that would have come from the private sector. In this situation, private investment that occurs regardless will be unnecessary, inefficient or diverted to less crowded markets that are also necessary to keep the economy running.

Table 1: EU-4 and US-Determinants of y/y change in total (private and public) infrastructure investment

		US	Germany	France	Italy	Spain
Coefficient	Endogenous variable	YoY change in infrastructure inv. (pub + priv)				
	Constant	2.18	-0.01	-0.03	-0.02	-0.06
	YoY GDP growth	1.83***	0.70***	2.44***	1.69***	3.07***
	Yearly variation in curve steepness	-5.84***	1.49**	2.17***	3.80**	2.90**
	Preference for the Future Index	0.85***	0.11	0.22*	-1.11***	0.42***
	Adj. R2	66.0%	24.8%	66.7%	59.2%	78.9%

Sources: Euler Hermes, Allianz Research.
*Note: ***= p<0.01, **=p<0.05, *=p<0.1. Lags for the variables slightly differ depending on the country.*

Figure 10: Germany, France, and US-Annual crowding-in effect of public investment on private investment (In real terms) [US (LHS), France and Germany (RHS)]



Source: Allianz Research.

THE LONG-TERM IMPACT ON POTENTIAL OUTPUT

The main channel of transmission of large infrastructure projects to long-term growth is through productivity due to a more efficient use of production factors such as labor, capital and information. However, scaling up public investment can also become increasingly inefficient in the presence of capacity constraints and potential waste. We differentiate both negative and positive effects of infrastructure investment on long-term growth in a simple ordinary least squares (OLS) regression model of potential growth with the following variables:[12]

- Change in the active population (expected positive sign)
- Change in productivity (expected positive sign)
- Variation in the debt to GDP ratio (expected negative sign due to crowding-out effects)
- Rise of investment to total public spending ratio (expected positive sign due to crowding-in effects)

Our estimation results strongly favor more public investment to lift potential output (Table 2). We find that the crowding-in effect of public investment far outweighs the crowding-out effect of higher public debt. The signs of the coefficients for the remaining variables are as expected, with a higher share of the active population and higher labor productivity raising potential output. Given the secular decline of potential output, we estimate that the additional fiscal impulse from current infrastructure plans can slow this trend, and, in the case of France, might even stop it (Figure 11). However, it remains to be seen whether the impact on productivity growth is similar (or higher) than that of past infrastructure projects. In addition, the projected level of public investment would need to be maintained.

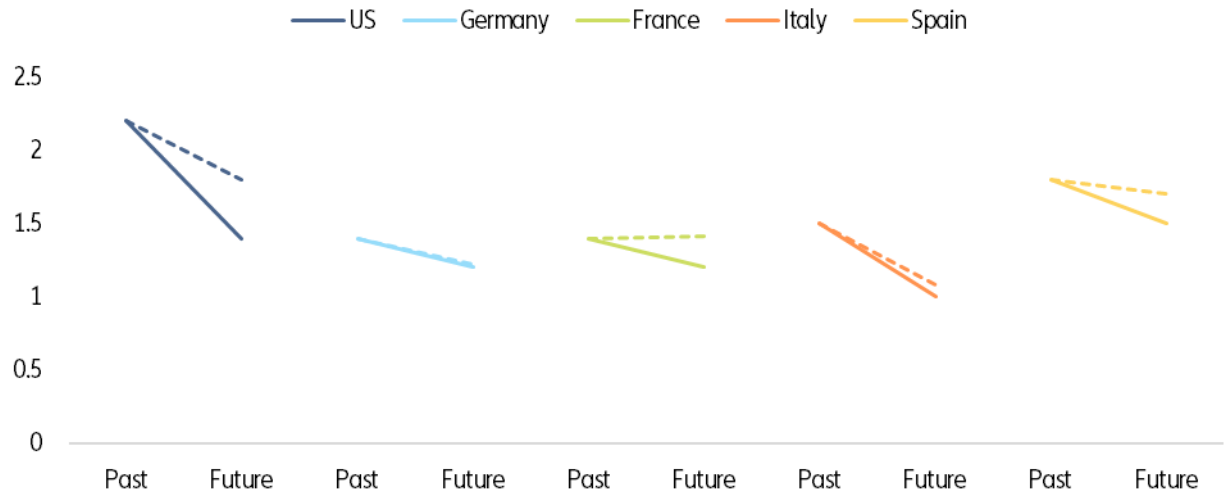
12 *See also Auerbach, Alan J. and Yuriy Gorodnichenko (2012), "Measuring the Output Responses to Fiscal Policy," American Economic Journal: Economic Policy, Vol. 4, No. 2, pp. 1-27.*

Table 2: Determinants of potential y/y GDP growth

		US	Germany	France	Italy	Spain
Coefficients	Endogenous variable	Potential YoY GDP Growth				
	Constant	2.33	0.01	0.01	0.01	0.01
	YoY Change in active population	0.10***	0.2	0.49**	0.37***	0.52***
	YoY Change in Labour productivity	0.05***	0.005***	0.004**	0.004***	0.007**
	Yearly variation on Debt/GDP	-0.01***	-0.002***	-0.001**	-0.001***	-0.002***
	Yearly variation on public investment/total public expenditure	0.16***	0.11	0.71**	0.13***	0.22***
	Imports	-0.18***				
	Adj. R2	77.4%	56.0%	32.3%	53.4%	50.8%

Sources: Euler Hermes, Allianz Research.
*Note: ***=p<0.01, **=p<0.05, *=p<0.1. Lags for the variables differ depending on the country. Lags for the variables differ depending on the country.*

Figure 11: EU-4 and US-Expected change in potential growth (in pp)



Sources: Euler Hermes, Allianz Research.
Note: "Past" = Average in the 2000-2020. "Future" = annual real GDP growth estimated for 2025-2030. Dotted line takes into account the conditional effect of planned infrastructure projects and infrastructure initiatives.

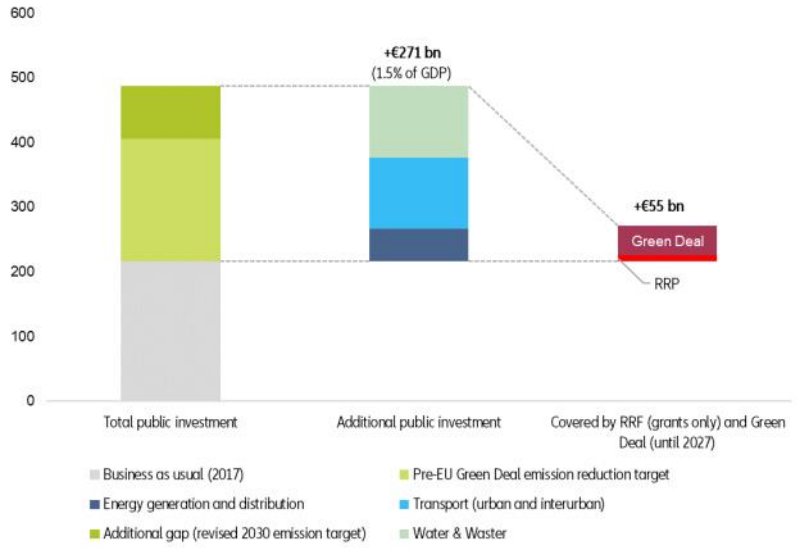
INVESTING FOR THE GREEN AND DIGITAL TRANSITIONS

We review the historical breakdown of infrastructure spending by sector to illustrate the potential resource reallocation to sectors with the largest de-carbonization potential (especially energy transition, transportation and buildings). In this context, we also assess whether planned investments via crisis-related infrastructure packages are sufficient for greening consumption and investment flows consistent with the national commitments to reduce greenhouse gas emissions by more than 50% relative to their 1990 levels until 2030 (Figure 12).

Figure 13 contrasts the sectoral distribution of public investment in the past with that of Recovery and Resilience Plans (RRPs) member states have submitted to the European Commission to seek funding via the NGEU. Although the categories are not directly comparable, we can see that a much larger share of infrastructure investment is directed to climate policy and the energy transition (around 40%), followed by digitalization. When it comes to greening, the devil is in the details (as we are reporting in our sector pathways[13] series). If we assume most climate-related funding will benefit the transport and utilities sectors, then the overall breakdown of public management would remain broadly the same, albeit with a "greener" focus.

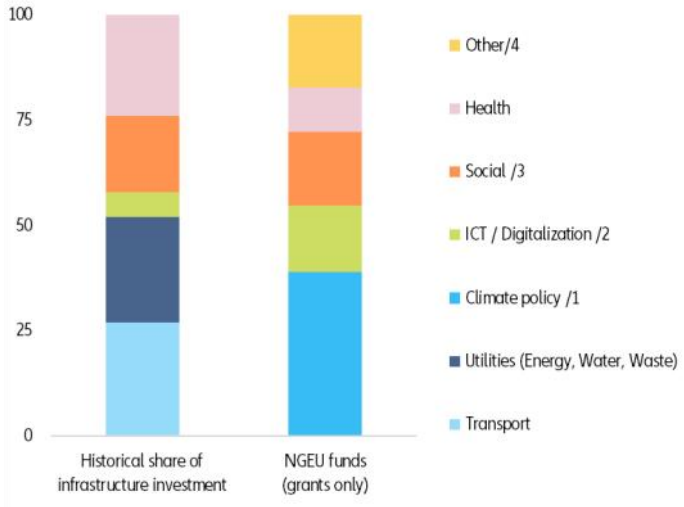
13 For additional background, please see our EU Sector Pathways report on Transport, Utilities and Oil and Gas.

Figure 12: EU: Average annual public investment needs for climate-friendly physical infrastructure (EUR billion, 2013 prices)



Sources: Allianz Research; European Commission; European Investment Bank; Jobst and Shabunina (2021).
*Note: RRP=resilience and recovery plan (RRP); "Green Deal" refers to the EU agenda for sustainable investment (prior to the NGEU) until 2030, of which 30% comes from the EU's multiannual budget (2021-2028). Calculations based on Jobst Andreas A. and Anna Shabunina (2021), "Considerations for Climate Change Mitigation in Ireland," Country Report No. 21/124, Ireland: Selected Issues, June (Washington, D.C.: International Monetary Fund). */ only the climate-relevant share of the grant element of RRP (37%); 1/ Increase of energy generation from renewables of at least 32% and increase of energy efficiency by 32.5%; 2/ Total net greenhouse gas emission reduction of 55% relative to 1990; 3/ Includes storage, refuelling and recharging infrastructure in the transport sector. Estimates do not include (1) private sector investment (including energy efficiency measures in buildings (residential and services) and industrial processes (manufacturing and process-driven emissions, including cement) as well as transport (e.g., vehicles)) and (2) social infrastructure (if relevant for climate change mitigation, e.g. public buildings). The average annual investment need of the former is estimated to be EUR227bn (in addition to "business as usual" spending of EUR209bn).*

Figure 13: EU-15: Sectoral breakdown of public investment and NGEU-RRP funds (In %, grants only)



Sources: Allianz Research; Euler Hermes; European Commission; Eurostat; national authorities; EIB; EPEC; IJ Global.
Notes: EU-15=EU with 15 member states prior to the expansion in 2004. The categorization within NGEU funds is based on a preliminary assessment of the national recovery and resilience plans covering investments. Unweighted country averages. 1/ includes renewable energy system, climate-friendly mobility and public support for energy-efficient housing. 2/ This category captures only digital infrastructure, but other categories have a high digital content as well (e.g., health, education, public administration); 3/ Social includes education, labor market and social inclusion. 4/ "Other"=public administration & governance, other public investment, R&D and agriculture.

Based on our previous analysis of the growth impact of public investment and the crowding-in effect of private investment, we assess critical aspects of the green and digital transition for infrastructure investment:

- **How big are the infrastructure investment needs?** According to our estimates, EU member states would on average need to raise annual public investment in physical infrastructure by at least 1.5pp of GDP to achieve the climate goal of emission reduction and energy efficiency.

- **What are the implications for the private sector?** How much additional private investment would be required even after accounting for the significant crowding-in effect of the massive infrastructure plans? We have done a simple calculation, based on the additional amounts from current infrastructure plans and the additional climate policy-rated capital spending (Table 3), which we also apply to the US for comparison. Compared with the calculated crowding-in of private investment for the long-term average level of public investment and additional infrastructure impulse, we observe that for France, especially after 2023, the needs could be almost be met. In the case of Germany, crowd-in effects for the private sector are also strong, but private investment will be insufficient (with only about one-fifth of remaining investment needs being covered). In the case of Italy and Spain, raising private investment will depend on whether possible crowding-out effects will indeed occur. In the US, crowding-in effects would average at about USD73bn per year, leaving USD137bn of private investment that still needs to be mobilized each year to satisfy additional investment requirements for the climate and digital transitions.

- **Are there any long-term and/or spillover effects?** The current scaling up of public investment might be the start for a more permanent fiscal impulse to raise potential output in light of the significant structural changes that lie ahead. One reason is that the current plans alone will not be enough to close the gaps that years of underinvestment have created, much less to achieve the ambitious climate change mitigation targets until 2030 and beyond. The current infrastructure plans will also have significant spillover effects from an economic and political perspective. The import of the necessary materials to implement infrastructure projects will support the growth of exporters but also raise demand for services from abroad. This will not only temporarily increase global demand but also boost the development of a new and modern network infrastructure system, with productivity gains that extend across borders. The current plans could also help balance infrastructure development in emerging market and developing countries (EMDEs) as important export markets for the US and EU. The increasing presence of China as a financier and operator of critical infrastructure in the EMDEs has already resulted in a loss of influence. In 2013, China launched its "One Belt One Road Initiative"[14] (OBOR) as part of its development strategy to improve connectivity and cooperation by linking China to Europe, Asia and Africa. In light of China's increasing presence in many EMDEs but also its stakes in main European ports, the US and the EU have (or will shortly do so) put in place programs to boost infrastructure abroad. The US has initiated the "Blue Dot Network" and "Build Back Better World", and together they aim at supporting infrastructure investment that is open and inclusive, transparent, economically viable, financially, environmentally and socially sustainable, and compliant with international standards, laws and regulations. In the case of the EU, the plan is known as "Global Gateway" and shares similar goals but is more limited in geographical reach (with a focus on Emerging Europe and Africa). The plan aims to mobilize EUR300bn, both from public and private sources, until 2027 for digital and climate projects as a better alternative to OBOR.[15] The scheme aims to strengthen Europe's supply chains, boost EU trade and help fight climate change, focusing on digitalisation, health, climate and the energy and transport sectors, as well as education and research.

14 It has different names, such One Belt One Road (OBOR), Belt and Road Initiative (BRI) or Silk Road Economic Belt.

15 The Vienna Institute for International and Economic Studies proposed the European Silk Road to connect industrial centres in Western Europe with regions in the East of the continent to generate more growth and employment. This proposal argues for a big push in infrastructure investments in Europe, with needs estimated at EUR1 trillion (Holzner, 2019).

Table 3: EU-4 and US: Amount of annual funding shortfall of public investment for climate change mitigation (EUR bn; except US, in USD bn)

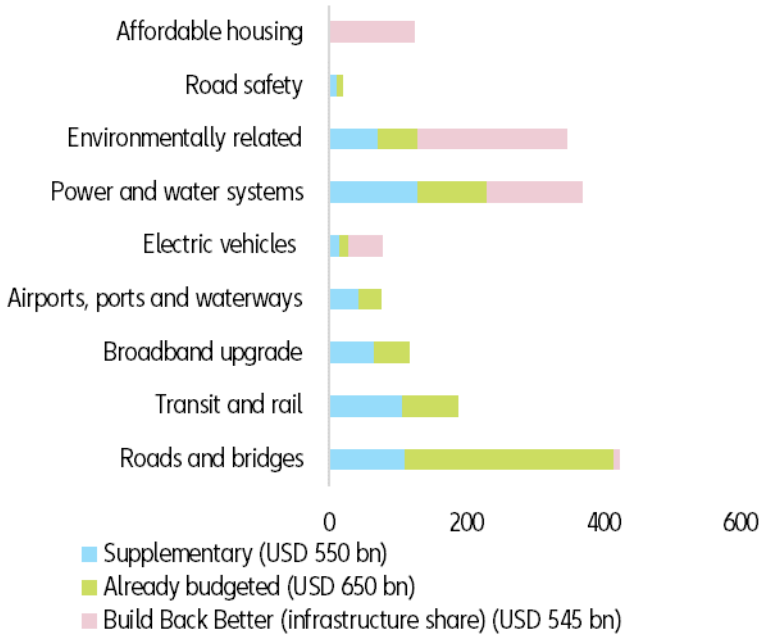
	Avg. amount of additional public invt. via infrastructure initiatives 1/	Avg. amount required to meet new invt. needs (1.5% of GDP)	**Avg. amount of private capital needed to close the funding gap**	Estimated avg. crowding-in effect from infrastructure initatives	**Estimated avg. funding shortfall**	*Memo item: current public invt. in infrastructure (2020)*
US	**160**	370	**210**	73	**137**	373
DE	**1.1**	60	**59**	9	**50**	40
FR	**1.4**	42	**41**	31	**10**	57
IT	**6.5**	30	**24**	n.a*	**24**	17
ES	**6.7**	20	**13**	n.a*	**13**	16

Source: National Sources, Euler Hermes, Allianz Research.
*Note: */ Potential crowding-out effect of current infrastructure investment plans; 1/ Infrastructure packages in the US (Bipartisan Infrastructure Deal (Infrastructure Investment and Jobs Act) and Build-Back-Better (BBB) Framework) and the EU (Recovery and Resilience Facility as part of the Next Generation EU recovery package) – for the latter, only the grant element is considered; 2/ see Figure 10 above for the estimated crowding-in effect.*

Appendix I: Details of US Infrastructure Plan

The US infrastructure package has been adopted by the Congress. It is made up of USD550bn of supplementary spending compared with existing law already budgeting USD650bn to be invested at the horizon of 2031. Another major source of infrastructure spending can be potentially found in the Build Back Better Framework for a total of USD735bn to be spent over the same horizon (Figure A1.1).

Figure A2.2: Federal investment into infrastructures (USD bn, 2022 – 2031)



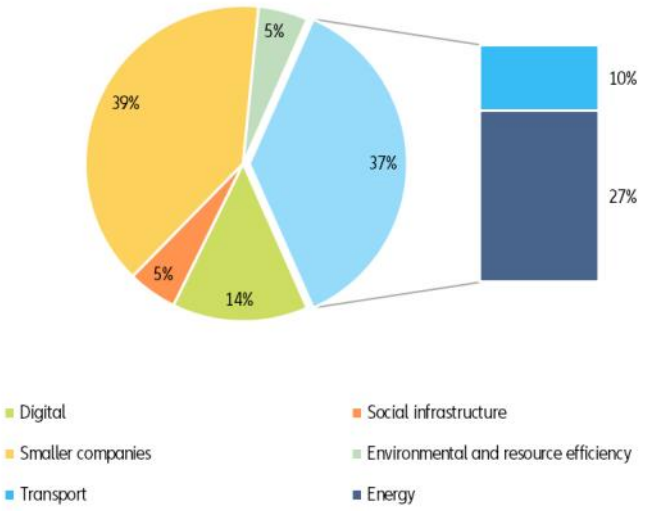
Appendix II: Details of the EU infrastructure plan

In May 2020, the EC proposed an EU-wide recovery package (Next Generation EU) to finance investment in a "green, digital, and resilient Europe." The NGEU is a one-off augmentation of the EU's Multi-annual Financial Framework for 2021–27, funded by EUR750bn of EU debt issuance to be repaid over 30 years via new (planned) tax receipts accruing to the EU budget (e.g., proceeds from the carbon border adjustment mechanism, a digital sales tax, levies on large multinational corporations). More than half of the funds would be disbursed as grants, while the rest would take the form of loans and provide guarantees to the EIB.

However, only a small share of the NGEU funding will flow into infrastructure investment. While the scale-up of the current EU-wide investment program (InvestEU) through NGEU grants will predominantly benefit infrastructure projects (Figure A2.1), only a small part of the funding for national initiatives through the Recovery and Resilience Facility (RRF) will directly flow into additional physical infrastructure projects with a focus on digitalization, green transformation, and "resilience." We have assumed that around 20%[16] of the total amount given to the countries will be used for infrastructure projects.

Most of the NGEU-RRF funding will be through grants (Figure A2.2). The country distribution of the grants is not fully known, as 30% of the RRP are subject to a review in June 2022. When it comes to the loans, it will depend on the amount available for each country and the amount requested by countries. Given that the grants and the loans are part of the same package, it is realistic to assume that the amount provided for loans (maximum) will be distributed in a similar way as the grants. Vulnerable member states are more likely to borrow as part of an EU plan than funding themselves in the capital markets. In aggregated terms, around 80% of the available loans within the SURE[17] programs were used; Spain used 84% and Italy 97%. To remain on the conservative side, we have assumed that 80% of them will be used by Italy and Spain. The case of Germany and France is different as their already favorable financing conditions make them less prone to using a loan-type support (neither of them made use of SURE).

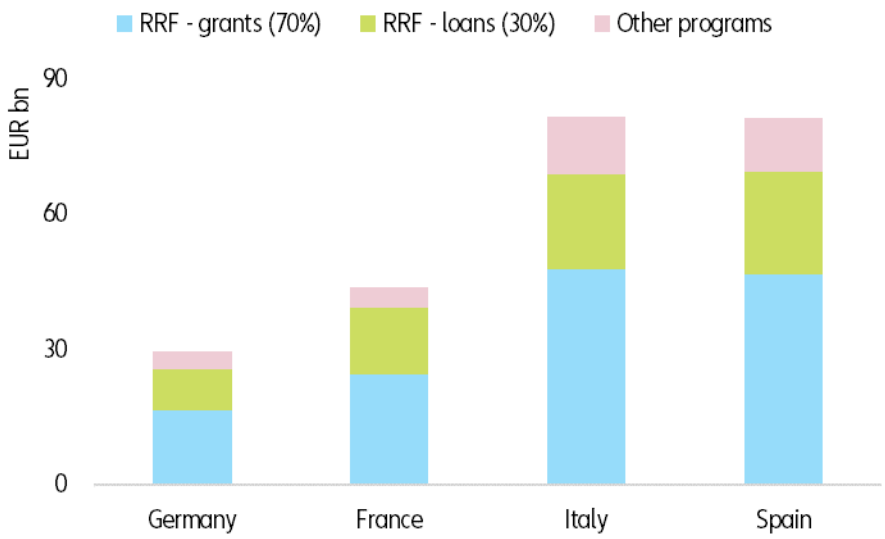
Figure A2.1: EFSI 2.0/Invest EU: Sectoral Breadown of Investments (July 2018)*



Source: European Investment Bank.
*Note: EFSI=European Fund for Strategic Investments ("Juncker Plan"); */ excludes research and development projects.*

16 *The 20% was derived based on the average allocation of funding to climate action, digitalization, and healthcare systems.*
17 *SURE= Support to mitigate Unemployment Risk in an Emergency (April 2020).*

Figure A1.2: Distribution of NGEU grants (385.8 EUR bn in loans are not accounted).



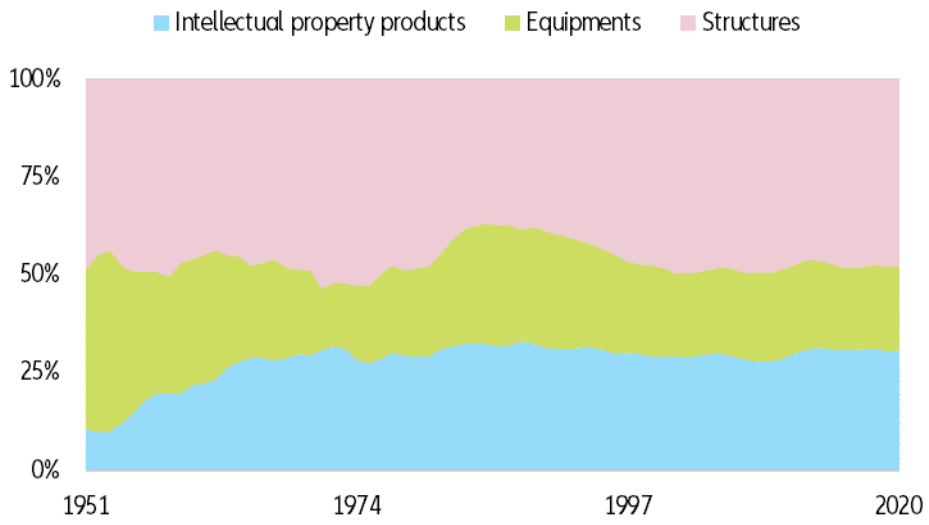
Source: European Commission, Allianz Research.
Note: Member states receive funding via the recovery and resilience facility (RRF) of the NGEU by submitting their recovery and resilience plans (RRPs), maximum per country.

Appendix III: Demystifying the measurement of public infrastructure investment

Public investment and public infrastructure investment are different. Many studies proxy public infrastructure investment with gross fixed capital formation reported in the national accounts. However, physical infrastructure represents only about 50% of total public investment (Figures A3.1 and A3.2). Thus, we focus on the sub-component "structures" of public investment as the most accurate estimate of infrastructure projects.

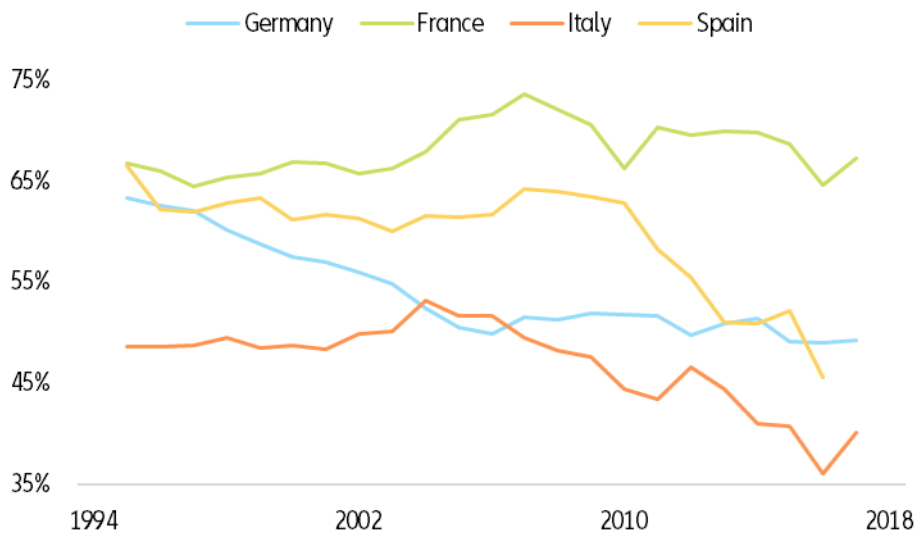
Public authorities are not the only ones having skin in the game when dealing with infrastructure projects. The high multiplier effects related to infrastructure projects relies on large crowding-in effects, i.e., a positive reaction of private investment following the government's impulse. Figure 3 shows the transmission effect, both negative (crowding-out effects) and positive (crowding-in effects). Public investment can be a source of both inefficiency (misallocation of resources) and productivity gains. Historically, a higher investment to GDP ratio of the public sector has not always translated into higher growth potential. This means large public infrastructure programs also need to be monitored for efficiency.

Figure A3.1: Share of sub-components in public sector investment (as % of total investment)



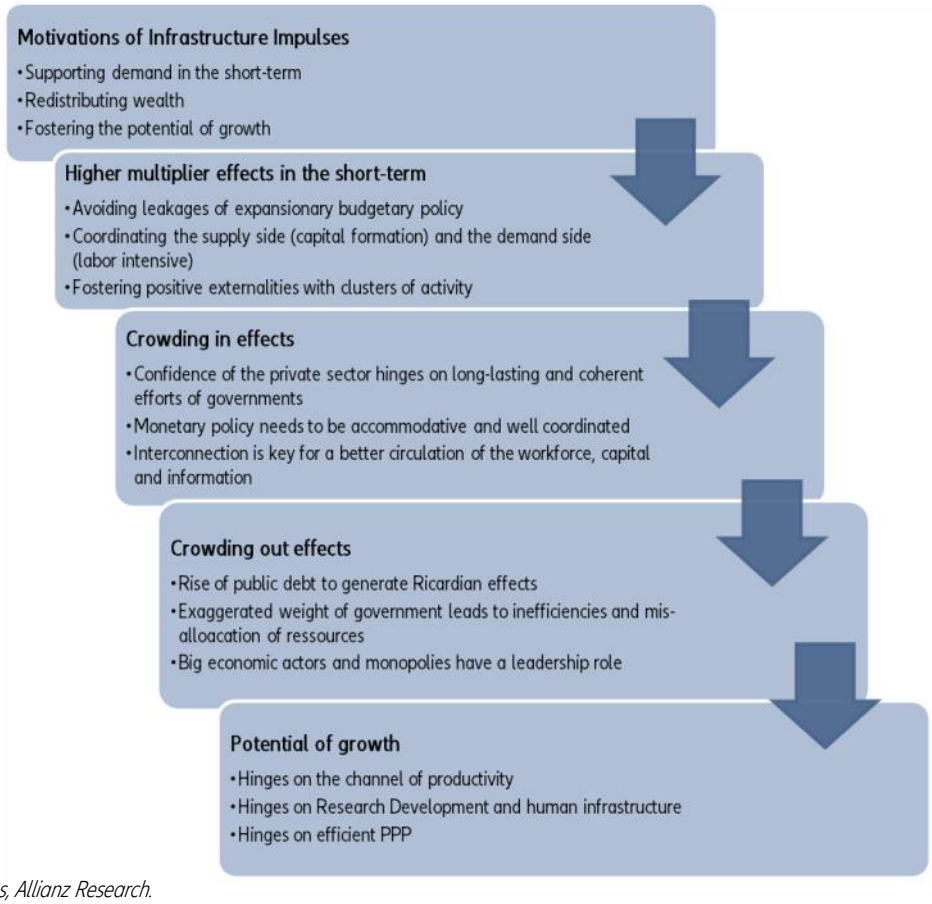
Sources: Bureau of Economic Analysis, Euler Hermes, Allianz Research.

Figure A3.2: EU-4—Share of infrastructure investment over total public sector investment



Sources: Refinitiv, EU KLEMS, Euler Hermes, Allianz Research.

Figure A3.3: Transmission effect of infrastructure projects



Sources: Euler Hermes, Allianz Research.

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